

AMENDMENTS TO THE CLAIMS:

The listing of claims will replace all prior versions, and listings of claims in the application:

LISTING OF CLAIMS:

1. (Currently amended) A method for self-synchronization of modular production systems having a plurality of components with a plurality of alternative capabilities for processing and transporting work units along at least one transport highway, wherein the components and the at least one transport highway are arranged in a configuration, the method comprising:

determining jobs of interest, wherein each said job includes not less than one work unit to be produced;

determining the configuration of the components and the at least one transport highway, wherein said configuration comprises at least one loop, and wherein the components include at least one machine module;

determining the duration time for each of the components, wherein said duration time comprises the elapsed time from receipt of a work unit at the component's input location to arrival of the work unit at the component's output location;

determining at least one default self-synchronization time, wherein said default self-synchronization time comprises a sum of component duration times associated with the at least one loop~~multiple of said duration time for said at least one machine module~~; and

optimizing said default self-synchronization time by adjusting at least one component duration time, wherein the optimized self-synchronization time comprises a multiple of the component duration time for a select machine module associated with the at least one loop;

wherein the components further comprise at least one off-ramp and at least one on-ramp;

wherein the configuration comprises at least two loops connected serially with shared highway segments, wherein each of said loops includes at least one machine module component associated with at least one off-ramp and at least one on-ramp and a plurality of highway segments, wherein said highway segments enable the work units to flow through said at least one component or to bypass said at least one components;

wherein determining the default self-synchronization time comprises determining the difference between the default duration time for bypassing the components and moving the work units through the components.

2-8. (Canceled)

9. (Original) The method for self-synchronization of modular production systems according to claim 1, wherein adjusting at least one component duration time comprises adding an adaptation time to the duration time of at least one selected component.

10. (Original) The method for self-synchronization of modular production systems according to claim 9, wherein said adaptation time comprises the difference between said duration time for at least one selected machine module and the default self-synchronization time for said selected machine module's configuration loop.

11. (Currently amended) A system for self-synchronization of modular production systems having a plurality of components with a plurality of alternative capabilities for processing and transporting work units along at least one transport highway, wherein the components and the at least one transport highway have a configuration, the method comprising:

means for determining jobs of interest, wherein each said job includes not less than one work unit to be produced;

means for determining the configuration of the components and the at least one transport highway, wherein said configuration comprises at least one loop, and wherein the components include at least one machine module;

means for determining the duration time for each of the components, wherein said duration time comprises the elapsed time from receipt of a work unit at the component's input location to arrival of the work unit at the component's output location;

means for determining at least one default self-synchronization time, wherein said default self-synchronization time comprises a multiple of said duration time for said at least one machine module; and

means for optimizing said default self-synchronization time by adjusting at least one component duration time;

wherein the components further comprise at least one off-ramp and at least one on-ramp;

wherein the configuration comprises at least two loops connected serially with shared highway segments, wherein each of said loops includes at least one machine module component associated with at least one off-ramp and at least one on-ramp and a plurality of

highway segments, wherein said highway segments enable the work units to flow through said at least one component or to bypass said at least one components;

wherein determining the default self-synchronization time comprises determining the difference between the default duration time for bypassing the components and moving the work units through the components.

12-18. (Canceled)

19. (Original) The system for self-synchronization of modular production systems according to claim 11, wherein adjusting at least one component duration time comprises adding an adaptation time to the duration time of at least one selected component.

20. (Original) The system for self-synchronization of modular production systems according to claim 19, wherein said adaptation time comprises the difference between said duration time for at least one selected machine module and the default self-synchronization time for said selected machine module's configuration loop.

21. (Currently amended) An article of manufacture comprising a computer usable medium having computer readable program code embodied in said medium which, when said program code is executed by said computer causes said computer to perform method steps for self-synchronization of modular production systems having a plurality of components with a plurality of alternative capabilities for processing and transporting work units along at least one transport highway, wherein the components and the at least one transport highway have a configuration, the method comprising:

determining jobs of interest, wherein each said job includes not less than one work unit to be produced;

determining the configuration of the components and the at least one transport highway, wherein said configuration comprises at least one loop, and wherein the components include at least one machine module;

determining the duration time for each of the components, wherein said duration time comprises the elapsed time from receipt of a work unit at the component's input location to arrival of the work unit at the component's output location;

determining at least one default self-synchronization time, wherein said default self-synchronization time comprises a sum of component duration times associated with the at least one loop multiple of said duration time for said at least one machine module; and

optimizing said default self-synchronization time by adjusting at least one component duration time, wherein the optimized self-synchronization time comprises a multiple of the component duration time for a select machine module associated with the at least one loop;

wherein the components further comprise at least one off-ramp and at least one on-ramp;

wherein the configuration comprises at least two loops connected serially with shared highway segments, wherein each of said loops includes at least one machine module component associated with at least one off-ramp and at least one on-ramp and a plurality of highway segments, wherein said highway segments enable the work units to flow through said at least one component or to bypass said at least one components;

wherein determining the default self-synchronization time comprises determining the difference between the default duration time for bypassing the components and moving the work units through the components.

22. (New) A method of self-synchronization of a modular production system, including:

selecting at least one work unit path through the modular production system;

identifying a configuration of components associated with each selected work unit path, wherein each configuration of components includes at least one transport highway, at least one machine module, and at least two moving components associated with each machine module, each transport highway including a plurality of highway segments arranged to transfer work units along the corresponding selected work unit path;

determining a component duration time for each machine module and moving component associated with each selected work unit path;

determining a segment duration time for each highway segment associated with each selected work unit path;

determining a default self-synchronization time for each selected work unit path, wherein each default self-synchronization time includes a sum of component and segment duration times associated with the corresponding selected work unit path; and

determining an adjusted self-synchronization time for each default self-synchronization time by increasing at least one component or segment duration time associated with the corresponding selected work unit path, wherein each adjusted self-synchronization time is an

integer multiple of the component duration time for a select machine module associated with the corresponding selected work unit path.

23. (New) The method of claim 22 wherein the configuration of components for a first selected work unit path includes a first transport highway, a first machine module, and a first off-ramp and a first on-ramp associated with the first machine module, the first transport highway including a first plurality of highway segments arranged to enable a work unit to flow through the first off-ramp, first machine module, and first on-ramp.

24. (New) The method of claim 23 wherein determining the default self-synchronization time for the first selected work unit path includes summing component and segment duration times along the first selected work unit path when the work unit flows through the first machine module to obtain a flow-through sum.

25. (New) The method of claim 24 wherein the first plurality of highway segments are arranged to enable the work unit to bypass the first off-ramp, first machine module, and first on-ramp.

26. (New) The method of claim 25 wherein determining the default self-synchronization time for the first selected work unit path includes summing the segment duration times along the first selected work unit path when the work unit bypasses the first machine module to obtain a bypass sum and determining an absolute difference between the bypass sum and the flow-through sum.

27. (New) The method of claim 23 wherein the first plurality of highway segments are arranged to enable the work unit to flow through the first off-ramp, first machine module, and first on-ramp for at least one additional cycle.

28. (New) The method of claim 23 wherein the configuration of components for a first selected work unit path includes a second transport highway, a second machine module associated with the second transport highway, a second off-ramp and a second on-ramp associated with the second machine module, the second transport highway including a second plurality of highway segments arranged to enable the work unit to flow through the second machine module.

29. (New) The method of claim 28 wherein determining the default self-synchronization time for the first selected work unit path includes summing component and segment duration times along the first selected work unit path when the work unit flows through the second machine module to obtain a flow-through sum.
30. (New) The method of claim 29 wherein the second plurality of highway segments are arranged to enable the work unit to bypass the second off-ramp, second machine module, and second on-ramp.
31. (New) The method of claim 30 wherein determining the default self-synchronization time for the first selected work unit path includes summing the segment duration times along the first selected work unit path when the work unit bypasses the second machine module to obtain a bypass sum and determining an absolute difference between the bypass sum and the flow-through sum.
32. (New) The method of claim 28 wherein the second plurality of highway segments are arranged to enable the work unit to flow through the second off-ramp, second machine module, and second on-ramp for at least one additional cycle.
33. (New) The method of claim 28 wherein the first and second plurality of highway segments are arranged to enable the work unit to serially flow through the first off-ramp, first machine module, first on-ramp, second off-ramp, second machine module, and second on-ramp for at least one additional cycle.
34. (New) The method of claim 22 wherein the configuration of components for a first work unit path includes a first transport highway, a first machine module associated with the first transport highway, first off-ramp and first on-ramp associated with the first machine module, a second transport highway, a second machine module associated with the second transport highway, second off-ramp and second on-ramp associated with the second machine module, the first and second transport highways including a plurality of highway segments arranged to enable a work unit to flow through either the first or second machine module.

35. (New) The method of claim 34 wherein determining the default self-synchronization time for the first selected work unit path includes summing the component and segment duration times along the first selected work unit path when the work unit flows through the first machine module to obtain a first flow-through sum, summing the component and segment duration times along the first selected work unit path when the work unit flows through the second machine module to obtain a second flow-through sum, and determining an absolute difference between the first flow-through sum and the second flow-through sum.

36. (New) The method of claim 34 wherein the plurality of highway segments are arranged to enable the work unit to bypass both first and second machine modules.

37. (New) The method of claim 34 wherein the plurality of highway segments are arranged to enable the work unit to flow through either the first or second machine module for at least one additional cycle.

38. (New) The method of claim 22 wherein determining each adjusted self-synchronization time includes determining an adaptation time for the corresponding default self-synchronization time and allocating the adaptation time to the at least one component or segment duration time associated with the corresponding selected work unit path.

39. (New) The method of claim 38 wherein determining the adaptation time includes determining a difference between i) a product of the multiple of the component duration time for the select machine module and a work unit rate for the select machine module and ii) the default self-synchronization time for the corresponding selected work unit path.